Matrix Information & Directory Services

Matrix News

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Editorial: Technology, Communities, and Economics

This month's Matrix News balances technical and social issues. Since networks do not stop at national borders, and Matrix News was never intended to be only about domestic networking, we also present some international material. Partly to remind ourselves that networks can be fun, we even include some humorous material.

In "X.400, Fact and Fancy," Smoot Carl-Mitchell explains how the international standard Message Handling System works, why it is often regarded as the next major step in electronic mail, and some problems it has encountered on the stairs.

Then "Networks from Technology to Community" by John S. Quarterman describes how faster networks lead to new services, then new uses, then communities.

The "National Network Policy" article of last month sparked some interesting responses, which provoked this month's followup article, "National Network Players."

This issue also inaugurates two regular guest columns, Martian Packets and Acronet Soup. In Martian Packets, our guest column, Marty Schoffstall tells us that people matter more than organizations in creating new technology. We invite others with definite, serious, (and preferably outspoken) views on networking to send us their own guest pages for publication in Martian Packets.

Acronet Soup is a regular feature of interesting historical or humorous commentary on networking. This month, the origin of Martian Packets will be described which also serves to explain the name of the other regular column. This month, Daniel Karrenberg also tells us how IP got RIPE in Europe. Submissions for Acronet Soup should be interesting, unusual, and preferably funny.

There is a brief calendar of upcoming network events, from information collected by Susanne Wilhelm.

A reader remarked of Matrix News that he wished we would label articles as news or opinion. "X.400, Fact and Fancy," is mostly fact, with some opinion. "Networks from Technology to Community" is almost wholly opinion, based on experience. "National Network Policy" is a factual clarification supporting an opinion, plus some related information. Martian Packets is opinion and this month's Acronet Soup is fact. The calendar is factual, as far as we know. While I suspect that the reader wanted a finer grain of labeling, the nature of the subjects treated here does not lend itself to that. That is, I could label what I think is opinion in "Networks from Technology to Community," but others might not agree with me.

The last item included is a subscription form. Interest in Matrix News so far is promising. We distributed about a thousand copies of the first issue, about half by post, and the rest at conferences or through other organizations. As you can see, we were encouraged enough by the resulting subscriptions to add more material this month. We encourage still more subscribers so we can print more useful information.

Finally, we invite submissions for publication. Martian Packets (the serious guest column) and Acronet Soup (the humorous one) are designed for guest authors. In addition, we want articles. If you have experience or opinions to relate about an issue that crosses network boundaries, please contact us at mids@tic.com, or through our other addresses or numbers listed in the back.

John S. Quarterman Editor, Matrix News

X.400 - Fact and Fancy by Smoot Carl-Mitchell

Overview

X.400, the Open Systems Interconnect (OSI) Message Handling System (MHS), is the "Flagship Protocol" in the OSI stack. Some see it as a key step towards universal interoperability, where everyone can send and receive electronic messages as part of a worldwide community. Others see X.400 as an overly large and complex systems, which will stifle innovation and become an albatross around the networking community's neck. Both viewpoints have their ardent proponents. The truth, or rather the practical reality, lies somewhere in the middle.

X.400 is complicated. In many respects it has to be, given the goals of the standard. While many people immediately think that X.400 is synonymous with electronic mail, X.400 is a generalized third party messaging system. While it can easily be used for electronic mail (in OSI parlance Interpersonal Messaging or IPM), the protocol is sufficiently general that it can be used to transport fax messages, provide a vehicle for electronic fund transfer (EFT), or electronic document interchange (EDI) for invoices and orders. X.400 also supports multimedia messages which means it can transfer graphics and other non-textual information.

History

X.400 started life in the International Federation of Information Processing (IFIP) Working Group 6.5. in 1979. This group developed the requirements for Computer Based Messaging Systems (CBMS). In 1981 the International Telephone and Telegraph Consultative Committee (CCITT) Q5/VII Rapporteur Group was formed and this group developed the first X.400 specification published in 1984. This specification is known as the Red Book or X.400(84).

IN 1985 the CCITT Q33/VII committee was formed and developed a second specification published in 1988 known as the Blue Book or X.400(88). This specification moved a number of elements developed in the 1984 specification into the X.200 section of the

(see X.400 on page 6)

Networks from Technology to Community by John S. Quarterman

Networks are not just technology. Faster networks lead to new services, then new uses, then communities. This article discusses aspects of the history and near future of a few networks (the ARPANET, the Internet, UUCP, USENET, and BITNET) to illustrate some patterns that have occurred on many networks. The network services mentioned here are intended to be typical. If your favorite service is omitted, I'd be interested in hearing how you think it fits (or doesn't fit) in this scheme.

The perceptive reader will have noticed that I haven't mentioned X.400. Fortunately, the article by Smoot Carl-Mitchell in this issue of Matrix News discusses X.400 in detail. The technological information in the first three quarters of the paper is actually background to the sketch of community and society in the remainder of the paper.

Speeds and Services.

As shown in Figure 1, available network speeds tend to grow in jumps. The ARPANET used 56Kbps links for more than a decade. The Internet had 10Mbps Ethernet speeds commonly available from its inception in 1983, but used 56Kbps long distance links until about 1987, when T1 (1.544Mbps) started to be used. Since then, network speeds have begun to climb. A T3 (45Mbps) test network is in place, and faster wide area network speeds are expected. 100Mbps FDDI local area network speeds are now available. The speed increases shown for the years after 1990 are meant to be illustrative of a tendency for spurts every few years, with LAN speeds keeping somewhat ahead of WAN speeds. Such speed increases permit new services.

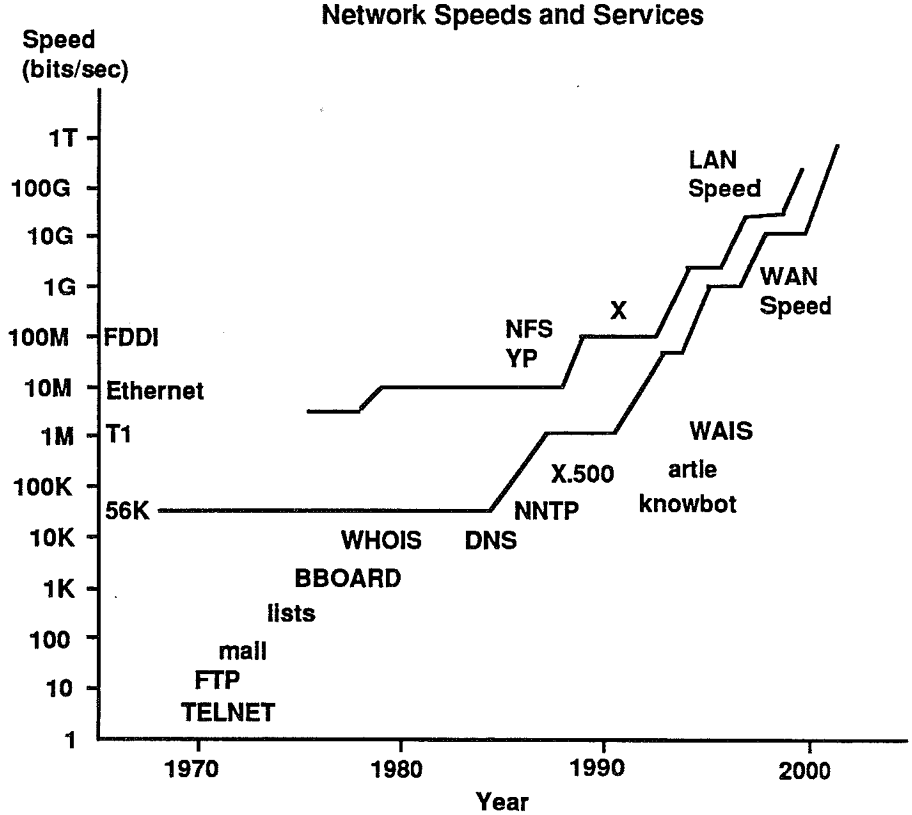
The ARPANET.

The earliest multi-site packet switched network, the ARPANET, was intended for resource sharing. That is, the sponsoring agency, ARPA (now DARPA, the Defense Research Projects Agency), thought a network to connect its sponsored organizations would be less expensive than buying new large computers for each of them. The organizations could just use the network to log in on each others' computers and transfer files between them. This approach influenced the naming of network constituents: connected computers with users were called *hosts*, because people from elsewhere could log in to them as guests. It also influenced network protocol terminology, as processes or computers with resources to share were called *servers*, and processes or computers that used those resources were called *clients*. Services like FTP (File Transfer Protocol) and TELNET (remote login) were part of the original network plan, and were implemented soon after the first ARPANET nodes were in place in 1969. Host names were mapped to network addresses by a central file on each host, updated from a master copy at a centralized site.

Early ARPANET users quickly discovered they wanted to use the network to send messages to each other about the status of their projects. This idea of electronic mail was first implemented as an addition to FTP (perhaps more accurately described as a "bag on the side"). This seemed natural at the time, since mail was placed in a mailbox file per user, and the name of the mailbox file could be taken from the destination user's login name. Mail was soon the most-used service on the network.

Users then discovered that they often wanted to send mail not just to specific people, but also to fixed groups of people, such as everybody participating in a particular implementation or planning task. These electronic mailing lists (or distribution lists) were implemented using aliases, that is, names that looked like mailbox names, but that were expanded by mail agents to lists of addresses for delivery. This illustrates that mail is something basically different from file transfer, since addresses in a mail alias may refer to users on any system reachable through the network, i.e., they are not limited to the sending or receiving (or controlling) host, as in FTP. That is, a mail transfer agent (MTA) distinct from FTP is useful. When the ARPANET mail specifications were rewritten in the late 1970s, they were separated from the FTP specifications, and implementations of the new Simple Mail Transfer Protocol (SMTP) server were separate from the FTP server.

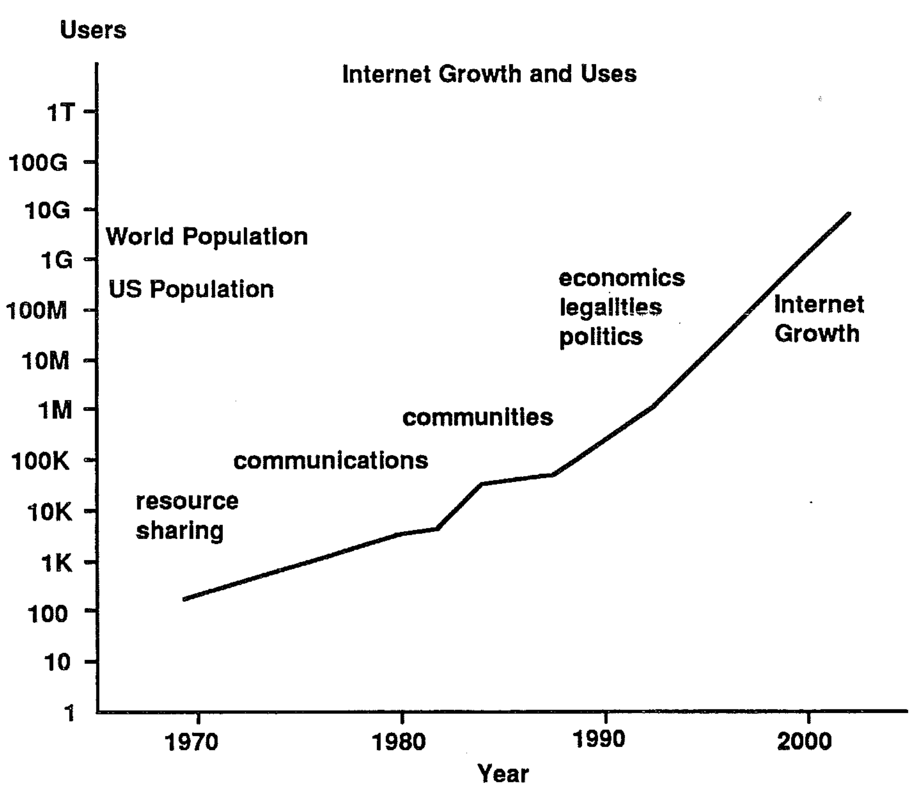
Figure 1
Network Speeds and Services



A next step was made when system administrators noticed that mailing lists involved a copy of the same message for each recipient on a host. This was a waste of disk space for large lists, since there were typically many users per host in those days. Many of those hosts were TOPS-20 or TWENEX systems. (These ran on Digital DEC-20 hardware; TWENEX was developed by BBN from Digital's TOPS-10 operating system, and later revised by Digital as TOPS-20.) On such systems, a mechanism called BBOARD became popular. Mailing lists could send one copy of a message to the BBOARD for each TOPS-20 host. Users would then use the BBOARD command to select a BBOARD and read the messages in the mailing list it corresponded to.

Eventually, there were enough users using mail, lists, and BBOARDS that they wanted ways to find each other's mail addresses and other contact information. The finger and WHOIS services were invented for this purpose. Finger shows information about users on a single system. WHOIS is a centralized database for a whole network, with access methods.

Figure 2



All this was on the ARPANET, before 1980, with links running at 56Kbps! But this information was presented not only as a historical overview of a particular case. The protocols and services of the ARPANET were direct ancestors of those of some other networks, especially the Internet. But there is a pattern here of resource sharing, mail, lists, groups, and user information services that recurs on many other networks, even unrelated ones. We will return to this pattern later in the article.

Local Area Networks

While the ARPANET was spreading all over the country and sprouting links to Hawaii and Norway, local area networks were being invented. Here we concentrate on Ethernet. The original Ethernet, as invented at Xerox had a theoretical maximum speed of 3Mbps, and was designed to throw away bandwidth. The later version from Xerox, Intel, and Digital, ran at 10Mbps, as did the protocol that was standardized as IEEE 802.3. Even though 10Mbps Ethernet was still designed to throw bandwidth away, 30% of 10Mbps is still 3Mbps, which is 53 times faster than 56Kbps. (It turns out that it really is possible to get 10Mbps transmission speeds out of 10Mbps Ethernet, but that is another story.)

56Kbps wasn't really fast enough (at least when multiplexed) to handle distributed file systems. Ethernet was. Xerox implemented a shared file system and a distributed name service, as did others, such as Apollo.

The Internet

Researchers involved with the ARPANET could see that one future of networking was interconnected sets of dissimilar networks, such as Ethernets connected by slower wide area networks of ARPANET-like technology. The Internet Protocol (IP) was invented to permit this, along with the Transmission Control Protocol (TCP), the User Datagram Protocol (UDP), and others in the TCP/IP protocol suite. In 1983, the ARPANET split into ARPANET (for network research) and MILNET (for operational use). Both ARPANET and MILNET became wide area backbone networks connecting local area networks into an internet, then called the ARPA Internet, now called just the Internet. All the old ARPANET services were available on the Internet as part of the new TCP/IP protocol suite.

The growth of the Internet was spurred by the release of the 4.2BSD version of the UNIX operating system in 1983 and its revision as 4.3BSD in 1986. Meanwhile, new hardware technology allowed faster, smaller, and cheaper computers to spread.

New companies, such as Sun Microsystems, were formed to take advantage of these developments. Sun invented a Network File System (NFS), which allowed relatively transparent remote access to files, unlike FTP, where the user has to explicitly transfer a file before using local native programs with it. NFS was written to be used on top of UDP (a TCP/IP transport protocol). It was made possible by the above developments, plus the availability of fast network technology such as Ethernet.

Such networked file systems brought a need for quick and distributed access across at least a local area network to information about users. For this purpose Sun provided YP (Yellow Pages, now known as NIS, for Network Information Service). NIS was designed for fast networks and is almost solely used on them.

Fast local area network speeds also permitted new variations on remote login. The X Window System was invented by MIT Project Athena around 1984. It, unlike NFS and NIS, is also fairly widely used over even fairly slow wide area networks, but its development was clearly spurred by fast network speeds. Similarly, the Andrew File System (AFS) can be used over slow networks, but was designed first on fast local area networks.

NSFNET

About 1984, proposals began to be drafted for a national supercomputer access network, later called NSFNET and deployed in 1986. This became the main backbone network in the Internet. The NSFNET backbone was implemented to use T1 (1.544Mbps) links about 1987. Experimental services such as packetized video and packetized voice began to be seen (some of these had been under development even on the old ARPANET, but weren't practical until higher speeds were available).

The ARPANET was retired from service in 1988 and 1989 because its link speeds were considered obsolete.

Meanwhile, an experimental T3 (45Mbps) testbed network is already in place.

Population.

Network speeds are not the only cause of invention of new protocols. Increasing numbers of networks, hosts, and users also have effects. Figure 2 gives very rough estimates of the user population of the ARPANET and then of the Internet from the beginning (1969) to the near future (2000). The ARPANET (pre-1983) figures are outright guesses. The Internet (1983-1990) figures were "computed" by multiplying the number of networks in the Internet by an average of 100 hosts per network and 10 users per host, or 1000 users per network.

The growth rate from about 1987 has been exponential, as the number of networks has doubled each year. The near future numbers (1991-2000) assume a simple continuation of this exponential growth. Obviously that can't continue forever, since we run out of people on the planet before 2000, but few who have tried to estimate Internet growth have shown any slacking in the exponential curve before the next five years or so. In fact, for the last year a doubling time of one year is clearly less than what is really happening.

Resource Naming

Meanwhile, Internet protocol developers had to contend with not just one or two networks, but hundreds, and anticipated thousands in a few years, together with tens or hundreds of thousands of hosts. The old centralized tables for mapping hosts to network addresses would no longer be adequate. A distributed host naming service, DNS (the Domain Name Service) was invented and deployed around 1984 to meet this need. This is one of the first examples of an Internet service that was clearly motivated by population pressures, not by higher available network speeds (e.g., DNS secondary servers just make a copy of the whole database). However, higher speeds later made the current very wide use of DNS practical.

People want to talk to people, not just machines. Computer networks rapidly become used for communication...

Similarly, the old-style WHOIS service eventually proved to be inadequate for large user populations. New services such as X.500 (the ISO name and directory service) have been implemented and deployed for this reason. No service has actually adequately met this need yet, and this is an active topic of network research and policy discussions.

Increased numbers of networks and hosts have led to an alphabet soup of network routing and management protocols to deal with them, but those are peripheral to the main topic of this paper, because users do not see them directly; they merely support other protocols.

Resource Access.

In a network of tens of thousands of hosts, it can be very difficult to find things. For example, FTP supports an access method called "*anonymous FTP*", which allows anyone to connect to a host that supports it with FTP, log in as user anonymous with password guest, and retrieve files left there for general use. Source code for programs, binaries of programs, archives of mailing lists, protocol specifications, and a plethora of other information is available from anonymous FTP servers. But which anonymous FTP server host has the files you want? The traditional method of finding out is by polling or word of mouth, not very efficient.

A newer method is illustrated by the *archie* service of McGill University in Montreal. The archie server looks at a list of anonymous FTP servers, polls each one and retrieves an index from it, and keeps the indexes on a single host. Users may then connect to the archie server and examine these indexes to determine which anonymous FTP servers have the files they want.

Similarly, the Knowbot Information Service (KIS), or *knowbot* for short, developed by the Corporation for the National Research Initiative (CNRI) automates searching servers that provide user directory information. A knowbot can be configured to use the WHOIS service, the X.500 service, the finger service on an appropriate host, and other services, to fetch information about a user (or perhaps about a host, network, domain, or organization). Some formatting is done on the retrieved information to make it more legible, but no attempt is made to merge what comes from different servers, nor are relative values given.

Information Access.

It would be even more useful if computers could be used to automate choosing information, not just finding it. A step in this direction has been made with the Wide Area Information Service (WAIS), recently operational on the Internet. WAIS not only assists in locating servers, but also accepts rules from the user that help it determine what information to select. It can also be configured to keep looking and inform the user of new information.

Meanwhile, USENET news, which had developed independently on the UUCP dialup network at speeds of first 300bps, then 1200bps, 2400bps, and finally 10Kbps, had grown very popular by about 1988. The USENET news network had about 400 newsgroups at that time. Newsgroups are discussion for a somewhat similar to mailing lists, but kept per hosts like BBOARDS, and different from both in being much more widely distributed geographically (worldwide) and somewhat more independent of underlying hardware or software platform (most USENET hosts run UNIX, but there are also MS-DOS, VMS, CMS, etc. hosts).

The amount of traffic became the main problem in keeping the network running. Successively faster modem speeds had per-

mitted it to continue to grow, but even 10Kbps became too slow. Fortunately, many of the main USENET hosts were also on the Internet, and the new NSFNET T1 backbone allowed even more traffic. Since USENET news over UUCP over TCP over IP was not particularly efficient or convenient, the Network News Transfer Protocol (NNTP) was invented to allow convenient distribution of news over the Internet.

There are hundreds or thousands of online communities today, many geographically distributed.

People.

There is clearly a pattern of networks permitting services (e.g., FTP) that are then used to build other services (e.g., mail). Faster network speeds then allow more transparent relatives of the earlier services (e.g., NFS) and also new services (e.g., X, although some say it is just a spiffy kind of TELNET). Population pressures combine with available speeds to permit and demand more transparent and distributed services (DNS, X.500, NNTP). Eventually, increasing population requires development of services to find and access other services (archie, knowbot). Finally, services are needed that not only find and retrieve information, but that also actually interpret it for you (WAIS).

But the more interesting aspect of this cumulative development of network services is what people do with them.

Resource Sharing

The original goal of the ARPANET was resource sharing. This was also the goal that was used to justify funding of NSFNET, and is one of the goals being used to justify the proposed NREN (National Research and Education Network).

Being able to explicitly access a computer located elsewhere is good and useful, as is being able to retrieve someone else's program or data. Resource sharing is essential to research and development or commerce. It is usually the first goal of R&D or enterprise networks. The first use of new network speeds is often more sophisticated resource sharing, e.g., NFS, YP, and X.

Even the USENET network developed from the UUCP mail network. UUCP stands for UNIX to UNIX CoPy, and the underlying protocol does file transfers and remote job execution. Mail is implemented as a combination of the two. News was added later by the same kind of combination. But resource sharing preceded communication on UUCP and USENET, just as it did on the ARPANET.

Communication

People want to talk to people, not just machines. Computer networks rapidly become used for communication, thus known as Computer Mediated Communication (CMC). Mail was quickly invented on the ARPANET and UUCP. Even BITNET, whose underlying support mechanism emulates punch cards, has mail as its most widely used service.

Places

People want to talk to not just individual other people, but also to groups. Mailing lists develop on every network that has mail. People begin to depend on them as places to get information or hear interesting news.

Travel

Given places, people begin to travel between them. Given enough places, navigation is necessary. Sophisticated management services like BBOARD, LISTSERV (on BITNET), and USENET news (with its many interfaces) develop.

At this level of sophistication, the appropriate metaphor for use of computer networks may not be communications, with its familiar analogies of telephones, paper post, fax, radio, and television, but travel, with its immediacy of experience and its tendency towards total immersion. A later article may discuss rapture of the netways....

Communities

Once you can go to other places and come back, you begin to notice there are some places you feel more comfortable or get more work done. People begin to frequent these places, and some develop into communities. There is a sort of evolution from resource sharing through communication, places, and travel to community.

Computer networks have never been used solely for work. One of the earliest online communities was probably the SF-LOVERS mailing list, which was widely distributed over the ARPANET as early as 1978, despite never being sanctioned by any network authority, and several actual attempts to suppress it. There are hundreds or thousands of online communities today, many geographically distributed. These include not only the publicly advertised USENET newsgroups and Internet, BITNET, and UUCP mailing lists. Such communities can form whenever a group of people decide to start a mailing list.

Many networks have been justified on the basis of resource sharing, and many people say they use networks for communications. But some of those who pioneered networks such as NSFNET say that the real purpose was to form or facilitate communities. These goals are not necessarily contradictory.

These networked communities are different in some ways from other communities. By the nature of the services and networks that support most of them, they are distributed, asynchronous, and recorded. They are also diverse, and many members of them say they are egalitarian.

Some people worry that networked communities are "thin" communities, in that they do not involve direct human interactions as in "thick" communities such as a baseball team, a musical group, or a neighborhood church. Probably more networked communities tend to be thin than, for example, work groups in businesses. However, many networked communities lead to interactions among their members by other means, such as traditional media like telephone and paper post, and especially by travel for personal meetings. Perhaps it would be better to say that the networks facilitate communities.

Computer networks have never been used solely for work.

Politics

Whenever you have communities of people, politics follows. The battles over the creation or charter of a USENET newsgroup can make old-time Chicago ward politics look tame. On a larger scale, the existence, funding, and access of the networks themselves have become political issues on local, national and international levels.

Politics in networked communities (or using network communications) may be

somewhat different than traditional politics, even about networks. Traditional communication media tend to fall into two groups. Paper press, radio, and TV reach mass audiences, convey information, and leave impressions. Paper post, telephone, and fax reach individuals, are interactive, and can be used for actions. Computer mediated communications can do both. Could this lead to accountability of leaders? And perhaps empowerment of citizens?

However, I will note that while power may come from the barrel of a gun, as Chairman Mao said, it is often preserved by secrecy. In networking, secrecy is not power, and may not even be possible. Therefore, networking is subversive. That may or may not be the opposite of electronic democracy, but I will avoid that discussion here.

It is interesting to remember that this has all been made possible by an early grant from the Department of Defense.

Economics

One of the reasons networks have become politicised is that some of them, such as the NSFNET backbone, are partly government funded and thus influenced by government-defined acceptable use policies. Government funding is provided by taxpayers, who often have differences of opinion over what their tax dollars should go for. One way out of that morass may be to privatize the networks, which would involve making them economically viable for commercial providers. This appears to be happening already.

Legal Issues

Where there are differences over money or politics, we often find lawyers. And, in recent years, sometimes the Secret Service or the FBI. But those are other stories.

Summary

I hope I have sketched the bumpy slope up from bits to barristers. Networks may start as solely technological tools, but they don't stay that way if they survive. They develop as places people go, which turn into communities, which develop politics, economics, and legal issues. The sum of all these things is a society. Radio and television produced a different society. Computer networks will, too. Perhaps this time we can avoid a few mistakes.

(X.400 cont)

OSI specification. Notably the definition of Abstract Syntax Notation One (ASN.1), a language for defining data objects in an abstract manner, was moved out of the X.400 specification in 1988. Another updated specification is due to be released in 1992. Most current implementations of X.400 are based upon the 1984 specification.

Technical Overview

X.400 is an applications protocol which uses a reliable end to end transport protocol to deliver messages. In a pure OSI environment this transport protocol is likely to be either TP4 running on top of the CLNP or TP0 on top of X.25. TP4 is a reliable end to end protocol similar to TCP and CLNP is a connectionless network protocol similar to IP. Given the widespread deployment of TCP/IP, X.400 can also run on top of TCP by using the ISO Development Environment (ISODE) which provides for an emulation of the OSI Presentation and Session layers. This is also known as the RFC 1006 method. Figure 1 shows where X.400 fits into the OSI 7 layer model and how it can be made to operate on top of the TCP/IP stack.

X.400 is a generalized third party messaging system. The closest analogy is the post office. Like the post office an X.400 user places a message into the system by putting it in an electronic envelope and addressing the envelope. Like the post office, the contents of the envelope are opaque to the transport and routing mechanism. The message is delivered to the electronic analogy of the recipient's post office box where the recipient then opens the envelope and reads the message.

Figure 1

Application	End user services (X.400)
Presentation	Information representation
Session	Dialogue coordination
Transport	End to end protocols
Network	Addressing, routing, internetworking
Datalink	Framing issues; media access
Physical	Physical cabling and signaling

An X.400 message consists of the message envelope, also known as the transfer envelope, followed by the contents of the message. The transfer envelope contains information used by the MHS to deliver the message. Typical fields include a unique message id for tracing the message; the address of the originator and the recipient of the message; the priority of the message; the type of contents of the message; and trace information which tracks the message within the MHS.

The contents of the message consists of a heading followed by a number of body parts. The header defines the content type of each body part. For example the contents of a message may contain readable ASCII text followed by a chart in some binary graphical format. The headers of the message will indicate where each of these body parts is stored and each type of body part will be interpreted accordingly.

An X.400 MHS consists of a set of Mail Transport Agents (MTA) and a set of User Agents (UA). The MTAs are responsible for moving the message towards its final destination. The UAs are responsible for sending and receiving messages from an MTA. Figure 2 shows the relationship between MTAs and UAs in the MHS. Three major protocols, P1, P2, and P3, define the interaction among the MTAs and UAs. P1 is the protocol used to transport messages from one

MTA to another. P2 is the Interpersonal Messaging (IPM) protocol which defines the standard for the format and contents of messages intended to read by a human. P3 defines the interaction between a UA and an MTA. All these protocols are defined using ASN.1.

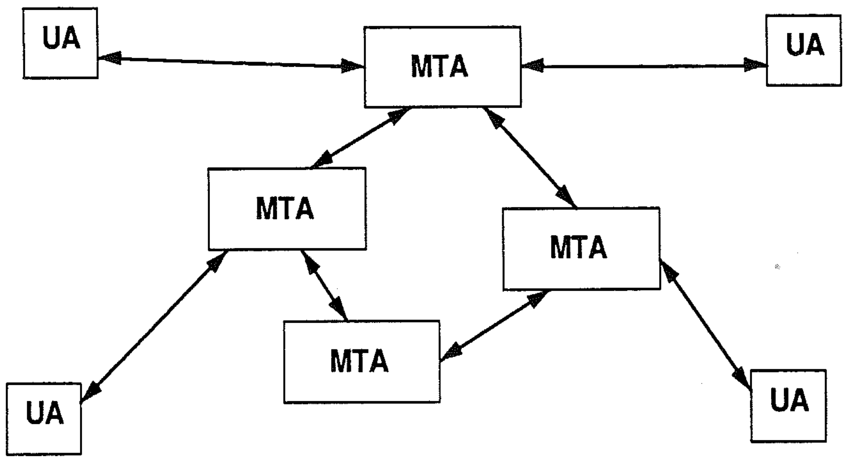
Theoretically X.400 defines a worldwide MHS where a message sent from one UA can be delivered to any other UA in the world. Clearly this is a very ambitious goal. To facilitate reaching this goal the MTAs are organized into Management Domains. A Management Domain can be either Public (ADMD) or Private (PRMD). Supposedly an ADMD is controlled by a public entity, such as the postal service and is available for use by the public. A PRMD is privately run, say within a corporation. A PRMD is expected to cooperate with ADMDs, but only deliver messages destined for users within their domain. As a practical matter the distinction between an ADMD and a PRMD is rather fuzzy. Both provide delivery service. The major distinction is an ADMD is supposed to provide service to the general public or businesses which cannot afford to establish their own PRMD. This distinction is probably valid for countries with government sanctioned telecommunications monopolies, but breaks down where telecommunication services are being provided by a number of competing vendors.

Addressing

Much like the post office, X.400 defines a standard addressing format known as Origin/Destination (O/R) addressing. An O/R address is a series of attribute/value pairs which uniquely identify the electronic location of the origin or destination of a message. For example the following is a stylized representation of an O/R address:
G=John/S=Smith/O=XYZ University/OU1=Computer Division/OU2=Software Unit/ADMD=telecom/PRMD=xyzu/C=US

This address says John Smith is in the Software Unit of the Computer Division at XYZ University and it is part of the PRMD known as "xyzu" which has an agreement with the ADMD called "telcom" and this University is located in the United States. Note that this representation is not the real format of an O/R address which is binary encoded as part of the message header, but is rather a human readable format. The UA does the translation from the human readable format to the real format defined in the standard.

Figure 2



Routing

Routing a message to its final destination is not a trivial task. The O/R address only gives "hints" as to how the message is to be sent. Within a PRMD a message router must decide which MTA within the PRMD will be the final destination and what is the best route to that MTA. A message destined for another PRMD or ADMD must be sent to the correct gateway. The issues involved in routing X.400 messages is far from solved and is similar to the general routing issues being worked on within the TCP/IP Internet. For the most part X.400 systems use static routing which can be non-optimal and as the system gets deployed widely can become very cumbersome to maintain.

A partial solution to the routing issue is to use the X.500 directory. X.500 is organized in a similar manner to O/R attributes and provides a lookup service which can simplify the maintenance of the X.400 message routing tables. However, X.500 is not widely deployed as of this writing and there are some technical as well as political issues to resolve. Getting everyone to cooperate to build what amounts to a worldwide electronic version of the phonebook is no easy task.

Future Prospects

The future of X.400 as a significant player in providing electronic messaging services is not in doubt. Despite its complexity, X.400 is here to stay and will become widely deployed. Curiously, even though it is an OSI protocol, it is likely to see widescale deployment within the ever growing TCP/IP Internet. Already there exists an experimental X.400 project within the Internet. Started as a sponsored project of the National Science Foundation, the X.400 Pilot Project is chartered to set up an experimental X.400 PRMD within the TCP/IP Internet community. The goals of the project are to gain experience in the operation of a PRMD and to ensure the MHS can interoperate correctly with the existing SMTP based mail system which is widely deployed and used on the TCP/IP Internet. The project will make recommendations on the final structure of the PRMD for the TCP/IP Internet based upon the experience gained during the experiment. The project has MHS connectivity with the European research community through the RARE MHS Project, as well as connectivity with other MHS providers in the US research community.

Conclusion

X.400 is a complex and in some ways a cumbersome system. The standards for it are difficult to read and at times hard to understand and decipher. However, X.400 is an accepted international standard and there are many vendors which have already developed implementations of the protocol. While not a perfect solution, it serves the purpose for which it is intended. X.400 will not be the final word in messaging systems, nor will it sit in a corner to gather dust, but rather it will be an important, if not universal, part of the networking village which continues to spread over the globe.

ACRONET SOUP

The Origin of RIPE by Daniel Karrenberg

I trust you know that acronyms are not abbreviations and usually the acronym is invented long before the title of the project :-). In the exceptional case of Reseaux IP Europeens this was a little different. For those interested in trivia I'll tell the story here once and for all:

I gave a talk at the 1989 meeting of AFUU (Association Francaise des Utilisateurs Unix) the French member organization of what used to be EUUG and now is EurOpen. During the talk I was asked about the then existing international IP networks and I drew a picture on an overhead foil. Apologetic as I am about not being able to give a talk in French I marked the foil "Reseaux IP Europeens" then and there to encourage people to ask further questions in French since I can understand French reasonably well.

A few months later I gave a talk elsewhere and John Quarterman (The Matrix) was nice enough to help me by turning my slides. I had mentioned to John that there were plans for an IP coordination activity in Europe. Lazy as I am I re-used the slide I had made for The AFUU meeting complete with French caption. When this particular slide came up I was slightly distracted by John giggling on the other side of the stage but thought nothing of it. After the talk John told me he had found a nice name for the coordination activity in my slides:

Reseaux
I
P
Europeens

For some reason (known to me) everyone present when the RIPE terms of reference were drawn up liked this name and it stuck. This is the only authorised version of the story! :-) :-) :-) :-)

<Turns out it's: RIPE Reseaux IP Europeens (European IP Networks). The adjective has to be plural to match Reseaux. This article first appeared 12 March 1991 as a message in the RIPE mailing list. It is reprinted here with permission of the author. -Ed.>

National Network Players by John S. Quarterman

The article "National Network Policy" in Matrix News Issue 1 brought some interesting comments that indicate clarification may be useful.

The hundreds of millions of dollars being dedicated to national networking include the current allocations of federal agencies such as NSF and DARPA, plus proposed allocations in the High Performance Computing Act, plus resources already committed by industry, plus resources likely to be committed by industry and state and local governments in the near future if commercial viability of a national public network becomes evident. Billions of dollars would probably be more accurate. Most of this is not federal money, and will not be directly controlled by Congress or by other governments. But all of it will be affected by what Congress does, and by what the early players already in position do.

As Mitchell Kapor (mkapor@eff.org) of the Electronic Frontier Foundation noted in his paper "Designing for Openness and Freedom in the National Public Network" of 9 April 1991,

Senator Albert Gore formally proposed the NREN for the second time in a bill brought before Congress this year, for which hearings were begun in March. President Bush implicitly endorsed the NREN in his 1991 budget. It looks increasingly likely that hundreds of millions will be committed to the project. Each federal dollar is likely to be matched with ten or more private sector dollars, as companies such as IBM and MCI continue to invest in research for the same user community. This leverages the federal investment enormously. But there are fundamental ambiguities about the purposes to which those funds will be put.

Even in the absence of further federal government involvement, national network policy discussions are needed among the other players and with their potential clientele. A public forum is still needed.

Since the last issue of Matrix News, a new player has appeared: CIX, the Commercial Internet Exchange. CIX is a consortium whose original members include PSI and UUNET (the two suppliers of commercial national backbone IP networks, PSInet and AlterNet) and CERFNET (a large California-based regional network). Their networks are interconnected directly. This means that CIX provides an extensive national IP network that is independent of the NSFNET backbone, and thus of many federal government acceptable use policies. It also means that these network railroads have agreed on a common track gauge for exchange of traffic.

Addresses for CIX and for those of its members that were not listed in the last issue are included below, as is an address correction for EDUCOM and an address for the sponsor of the Harvard workshops mentioned in the last issue.

The Origin of Martian Packets by Smoot Carl-Mitchell

Martian packets are not from Mars. Nor are they extraterrestial. The term comes from what was a common problem in the early days of the Internet. A "Martian Packet" is a packet from an unknown network which moves from router to router within the Internet. The situation is usually caused by an unregistered network connecting to the Internet. Effectively, hosts on this network are unreachable, but packets from these hosts can cause problems, so they are monitored and attempts are made to stamp them out. Usually this means a rude phone call from the network operations center. The phrase "martian packet" was coined, since the packets are not from a network anywhere on earth, they must be from Mars!

We named our serious column "Martian Packets" because we are interested in hearing from people with different viewpoints than the status quo in order to get people discussing and thinking about potentially controversial issues about networking. If you want to be a "Martian Packet" please get in touch with the editor.

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Calendar

A brief listing of conferences and workshops related to networking of open systems, through the end of 1991. This information was collected by Susanne Wilhelm of Windsound Consulting <sws@calvin.wa.com> and John S. Quarterman of MIDS. Further listings are solicited. We encourage others to reuse this information, but we ask for proper acknowledgment, for example by including this statement.

91 May 13-15	Telecom Developers '91 Hyatt Regency, DFW Airport, TX
91 May 20-24	Distributed Computing Systems IEEE, Arlington, TX
91 Jun 10-12	RIPE, Amsterdam, Netherlands
91 Jun 10-14	OIW NIST, G, MD
91 Jun 17-20	INET '91, Copenhagen, Denmark
91 Jul 29-Aug 2	IETF, BellSouth, Atlanta, GA
91 Sep 3-6	SICON '91 Raffles City, CC, Singapore
91 Sep 3-6	SIGCOMM '91 CETH, Zurich, Switzerland
91 Sep 9-13	OIW NIST, G, MD
91 Oct	RIPE Geneva area
91 Oct 7-11	Interop, CC, San Jose, CA
91 Dec 2-6	IETF LANL, Santa Fe, NM

Abbreviations:

CC	Conference Center
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
INET '91	International Networking Conference
Interop	TCP/IP Interoperability Conference
NIST	National Institute of Standards and Technology (U.S. Dept. of Commerce)
OIW	NIST OSI Implementors Workshop
RIPE	Reseaux IP Europeen (European IP Networks)
SICON '91	Singapore International Conference on Networks '91
SIGCOMM	ACM Special Interest Group on Communications

MARTIAN PACKETS

Making a Mark by Marty Schoffstall

Making a mark, creating a new paradigm, beginning a revolution have little to do with the commercial vs non-commercial issues. They have to do with individuals, individuals that go beyond just the idea but the execution of an idea. Sometimes it is an individual that brings a large institution to do something, but this is very, very rare at least in the US experience. (I'm not trying to be parochial merely focused). This individual can come out of academia, the business world, the government, or a church; it doesn't matter. Others can follow or copy and sometimes even overcome that "rugged individualist." But they aren't written in the history books with the likes of a: Gutenberg, Edison, DuPont, Moody, John Foster Dulles, JFK, Jobs, Perot, etc.

Nor do they change the shape of the way the culture/business/organization/market continues, creates new jobs, new wealth, or possibly new liberties. I'm very aware that this is in some sense the archetype American belief, and that there are many different beliefs about industrial, managemental, organizational philosophy; I've read and studied them both formally and informally. But I place it here as one man's thought, with a warning not to forget the purely human factor,

Marty

<This article originally appeared 15 March 1991 as a message in the mailing list com-priv@psi.com, which is about commercialization and privatization of the Internet. -Ed.>

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Network Addresses __________________

Which of the following networks or services do you routinely access?
TCP/IP Internet ____ BITNET ____ UUCP ____ USENET ____ MCIMail ____
CompuServe ____ AlterNet ____ PSINet ____ ANSNet ____ Other __________________

Which of the following electronic services do you routinely use on a network?
Electronic Mail ____ Electronic Mailing Lists ____ Electronic News or Bulletin Board ____
Remote File Transfer ____ Remote Login ____ Remote Job Entry ____

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